1894MNRAS..55...60C

## *Account of the Measurement and Comparison of a Set of Four Astrographic Plates, made at the Royal Observatory, Greenwich.*

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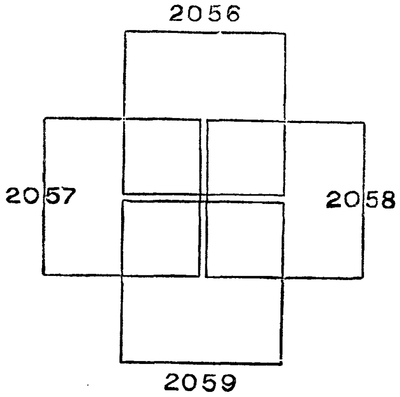
Before commencing the systematic measurement of the astrographic plates it seemed desirable to make a tolerably complete discussion of the measures in one particular case. For this purpose four catalogue plates were taken by Miss Everett on 1894 May 21. Each plate had three exposures of $6^m$, $3^m$, and $20^s$ respectively, the guiding star being placed successively at three of the angles of a square formed by spider lines 20″ apart in N.P.D. and R.A. respectively. The $3^m$ image is thus 20″ south of the $6^m$, and the $20^s$ image (for stars of ninth magnitude and upwards) 20″ due west of the $6^m$ image. The right ascension, declination, and mean distance of the plate during exposure from the meridian are :—

| No. of Plate. | R.A. | Declination. | E. of Meridian. |
|---|---|---|---|
| | h m | ° | m |
| 2056 | 16 50 | 67 | 70 |
| 2057 | 16 40 | 68 | 40 |
| 2058 | 17 0 | 68 | 40 |
| 2059 | 16 50 | 69 | 20 |

Thus the plates are arranged as in the accompanying diagram, a quarter of each plate overlapping one quarter of each of the two adjacent plates.



At Professor Turner's suggestion, a glass scale in connection with a viewing microscope was used for the measurement of the photographs, and it was found, as will be seen from the results here given, that this simple and rapid method gave the position of the star's image relatively to the *réseau* lines with sufficient accuracy. It was arranged to use a glass diaphragm with two scales at right angles, divided to $\frac{1}{20}$th of a millimetre (representing 3″ in the sky), which was made by Mr. Simms, the diaphragm being placed in the focal plane of the microscope of the astrographic micrometer. By means of the perpendicular slides

1894MNRAS..55...60C

of the micrometer, the star's image is placed accurately at the intersection of the two scales, and the position of the *réseau* lines relatively to it is read off on the two cross-scales by estimation to $\frac{1}{200}$th of a millimetre (0·001 of a *réseau* interval), representing $0''.3$ in the heavens. The coordinates of the $6^m$ and $3^m$ images of each star were measured both by Miss Everett (A. E.) and Miss Russell (A. R.). The measured places of the stars on two overlapping plates were compared by the method given by Professor Turner in the *Monthly Notices* for 1893 November (vol. liv. pp. 11–25). This method consists in deducing from the measured coordinates of a star on one plate what would be its coordinates on the second had the plates no errors arising from error of setting, of orientation, and differential refraction which were not equally shared by the two plates, the deduced places being then compared with the actual measured places on the second plate, and corrected by means of linear formulæ. If we call $x_1$ and $x_2$ the measured coordinate of the same star on the two plates, then from $x_1$ a quantity $x_{12}$ has been derived from the assumed settings of the plates : this does not differ far from $x_2$.

The quantities $x_2 - x_{12}$ have been formed for all the separate stars, and it is assumed that these can be represented by the formula

$$ax_2 + by_2 + c.$$

The quantities $a$, $b$, $c$, $d$, $e$, $f$ are determined, and the quantities

$$x_{12} + ax_2 + by_2 + c, \qquad y_{12} + dx_2 + ey_2 + f,$$

are the coordinates which the star would have had on the second plate, as given by the measures on the first plate, allowing for the errors of setting, &c., of the two plates.

The constants $a$, $b$, $c$, &c., were determined in several different ways. The results showed :—

1. That it was desirable to use a fairly large number of stars, say forty or fifty.

2. That the stars used for this comparison need not be confined to those which were within a limited distance of the centres of the overlapping plates.

3. That by dividing the stars into four groups—those on the top half, those on the bottom half, those on the left half, those on the right half of the quarter plate—and by taking the means for these four groups, the determination of $a$, $b$, $c$, &c., was practically as accurate as that obtained by employing the method of least squares.

When the plates were compared two and two in this manner, it was anticipated that $a$ and $e$ would vanish, and that $b$ would $= -d$. This amounts to assuming that the only errors not common to the two plates were errors of centring and orientation. When a slight error in the theoretical formulæ of transformation had been corrected (*Monthly Notices*, 1894 June, Supplementary Number, p. 573), the values found for the constants were as follows :—

1894MNRAS..55...60C

## TABLE I.

*Different determinations of the constants connecting two plates.*

Plate 2059 to 2057.

| Measurer | Exposure m | No. of stars used | *a* | *b* | *c* | *d* | *e* | *f* |
|---|---|---|---|---|---|---|---|---|
| A.R. | 6 | 59 | +·00017 | +·00131 | +·0244 | −·00102 | +·00017 | −·1004 |
| A.E. | 6 | 32 | +·00014 | +·00114 | +·0264 | −·00095 | +·00002 | −·1010 |
| A.R. | 3 | 46 | +·00031 | +·00116 | +·0159 | −·00102 | +·00022 | −·1037 |
| A.E. | 3 | 34 | +·00032 | +·00103 | +·0171 | −·00106 | −·00017 | −·1011 |
| | Mean | ... ... | +·00025 | +·00116 | | −·00101 | +·00006 | |

Plate 2056 to 2057.

| Measurer | Exposure m | No. of stars used | *a* | *b* | *c* | *d* | *e* | *f*. |
|---|---|---|---|---|---|---|---|---|
| A.R. | 6 | 48 | +·00020 | +·00172 | +·0271 | −·00174 | +·00003 | −·1248 |
| A.E. | 6 | 42 | +·00015 | +·00158 | +·0268 | −·00195 | +·00017 | −·1220 |
| A.R. | 3 | 40 | +·00031 | +·00166 | +·0208 | −·00170 | −·00005 | −·1260 |
| A.E. | 3 | 40 | +·00052 | +·00162 | +·0197 | −·00156 | −·00016 | −·1258 |
| | Mean | ... ... | +·00030 | +·00165 | | −·00174 | 00000 | |

1894MNRAS..55...60C

Plate 2056 to 2058.

| Measurer | Exposure<br>m | No. of stars used | *a* | *b* | *c* | *d* | *e* | *f* |
|---|---|---|---|---|---|---|---|---|
| A.R. | 6 | 58 | −·00035 | +·00022 | −·0303 | −·00041 | −·00006 | −·0126 |
| A.E. | 6 | 54 | −·00015 | +·00020 | −·0298 | −·00021 | +·00003 | −·0105 |
| A.R. | 3 | 46 | −·00029 | +·00029 | −·0231 | −·00050 | −·00012 | −·0129 |
| A.E. | 3 | 50 | −·00029 | +·00025 | −·0231 | −·00035 | −·00009 | −·0117 |
| | Mean | ... ... | −·00027 | +·00024 | | −·00037 | −·00006 | |

Plate 2059 to 2058.

| Measurer | Exposure<br>m | No. of stars used | *a* | *b* | *c* | *d* | *e* | *f* |
|---|---|---|---|---|---|---|---|---|
| A.R. | 6 | 68 | −·00006 | −·00040 | −·0271 | +·00042 | +·00002 | +·0289 |
| A.E. | 6 | 60 | −·00010 | −·00035 | −·0279 | +·00041 | −·00003 | +·0291 |
| A.R. | 3 | 60 | −·00007 | −·00012 | −·0240 | +·00033 | +·00010 | +·0266 |
| A.E. | 3 | 56 | −·00010 | −·00029 | −·0255 | +·00044 | −·00020 | +·0289 |
| | Mean | ... ... | −·00008 | −·00036 | | +·00040 | −·00003 | |

1894MNRAS..55...60C

An examination of this table shows—

1. A difference between the values of *c* as determined from the measures of the $6^m$ and $3^m$ images. This arises from different errors in the bisection of the guiding star at the two exposures. There seems also to be a very small difference in the value of *f*.

The quantities *c* and *f* are expressed in decimals of a *réseau* interval (5′), so that 0·001 denotes 0″·3. The quantities *a*, *b*, *d*, *e* are coefficients of the coordinates of a star, which in the extreme case may multiply quantities as large as 12 *réseau* intervals. Thus an error of 0·0001 in *a*, *b*, *d*, or *e* may give rise to an error of 0·0012 of *réseau* intervals, or 0″·36.

2. The quantities *a* and *e* cannot be taken = 0. The above table shows that *a* is not zero for 2059 − 2057, 2056 − 2057, 2056-2058: this may possibly arise from tilt in the plates. But the main part of *b* and *d*, as they are nearly equal and of opposite sign, seems to arise from difference of orientation error. The value of this difference in angular measure is (irrespective of sign) 4′ 43″, 1′ 18″, 5′ 50″, 1′ 3″ for the four comparisons.

3. The discordances between the values of the constants as given by the different measurers seem to be rather large in some cases, but it should be noticed that the discordances near the mean of the stars compared are much smaller. Thus, in 2059-2057, $c+7a+7b$, as determined by A.R. and A.E., only differ by ·0006 for the $6^m$ exposure, and by ·0004 for the $3^m$ exposure, although *c* as determined by the two differs by ·0020 and ·0012.

The sum of the constants *a*, *b*, *d* and *e* for a closed ring of plates ought to be zero. Changing the sign in the second and fourth case, so as to give constants for reducing plate 2059 to 2057, 2057 to 2056, 2056 to 2058, and 2058 to 2059, we obtain −·00024, +·00011, −·00004, +·00003 for the sum of the constants *a*, *b*, *d* and *e* respectively.

The discordances seem to arise from accidental errors in the measurement, and irregularities in the photographic image. The effect of these will be diminished if the means of the measures of the $6^m$ and $3^m$ images are considered as the coordinates of the star. In this way both images are used, and hardly any additional work is given to the computer beyond taking the means. A direct comparison has also been made—

1. Between the measures of the same image by the two measurers.

It was found that the personality of the measurers was very small, if at all appreciable. As a mean of 850 measures,

$$\text{AE}-\text{AR} = -0''\!\cdot\!1 \text{ in the horizontal coordinate}$$
$$= -0\cdot2 \text{ in the vertical coordinate.}$$

The mean discordance between the measures of the same image by the two observers was found to be ±0″·36.

2. Between the measures of the $6^m$ and $3^m$ images by the same observer : the mean discordance was in this case $\pm''\cdot 36$. There was just the same range as in the measures of the same star by the two measurers.

3. The mean discordance between a measured coordinate of a star on one plate and its coordinate computed from the corresponding measure on an overlapping plate was found to be $\pm''\cdot 45$. The fact that this is so slightly in excess of $\pm''\cdot 36$, the mean discordance between the measures of the same image by the two measurers, shows the validity and accuracy of the method adopted for the comparison of overlapping plates.

The following table is given to exhibit the accordance between the measures of different mesaurers of images of different exposures and of images on different plates :—

There are eight different measures to be compared. Miss Everett and Miss Russell's measures on plate 2057 of the $6^m$ images are given directly. From their measures of the $6^m$ images on plate 2059, the coordinates on plate 2057 were deduced by application of the constants given in Table I. Similarly from their measures of the $3^m$ images on plate 2059 coordinates on plate 2057 were deduced. Finally, the mean difference between the coordinates of the $6^m$ and $3^m$ images was applied to the latter. The mean of the eight different values was taken, and the discordances formed.

Columns 1 and 2 are the approximate coordinates of a star on plate 2057, given in *réseau* intervals, and measured from the centre of the plate.

Columns 3, 4, 5, 6 are the discordances from the mean of Miss Russell's and Miss Everett's measures of the R.A. coordinate of the $6^m$ and $3^m$ images on plate 2057. Columns 7, 8, 9, 10 refer to corresponding measures on plate 2059. The remaining eight columns give similar discordances for the other coordinate.

1894MNRAS..55...60C

## TABLE II.

*Comparison of Different Measures on Two Plates.*

| A Coord. on 2057. | B Coord. on 2057. | *Discordance of A Coordinate from Mean of 8.* | | | | | | | | *Discordance of B Coordinate from Mean of 8.* | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2057 | | | | 2059 | | | | 2057 | | | | 2059 | | | |
| | | A.R. 6$^{n}$. | A.E. 6$^{m}$. | A.R. 3$^{m}$. | A.E. 3$^{m}$. | A.R. 6$^{m}$. | A.E. 6$^{m}$. | A.R. 3$^{m}$. | A.E. 3$^{m}$. | A.R. 6$^{m}$. | A.E. 6$^{n}$. | A.R. 3$^{m}$. | A.E. 3$^{m}$. | A.R. 6$^{m}$. | A.E. 6$^{m}$. | A.R. 3$^{m}$. | A.E. 3$^{m}$. |
| + 2·8 | − 0·6 | −″·21 | +″·09 | −″·01 | −″·61 | +″·39 | +″·39 | −′·01 | −″·01 | +″·01 | +″·31 | +″·21 | +″·21 | +″·01 | +″·01 | −″·39 | −″·39 |
| 3·3 | 0·2 | +·83 | +·23 | +·43 | −·77 | +·23 | ... | +·13 | −1·07 | −·15 | −·45 | −·85 | −·55 | +1·35 | ... | +·65 | ... |
| 5·1 | 0·2 | +·10 | −·50 | ... | ... | +·40 | ... | ... | ... | +·10 | −·20 | ... | ... | +·10 | ... | ... | ... |
| 5·7 | 1·1 | −·07 | −·07 | −·17 | −·17 | −·07 | ... | +·43 | +·13 | −·37 | −·07 | −·47 | −·17 | −·07 | ... | +·43 | +·73 |
| 12·4 | 0·6 | −·59 | −·29 | −·09 | +·51 | −·29 | +·31 | −·09 | +·51 | −·36 | −·06 | +·14 | −·46 | +·24 | −·36 | +·14 | +·74 |
| 12·5 | − 0·6 | −·34 | −·34 | +1·06 | −·14 | −·04 | −·34 | +·16 | ... | −·04 | −·34 | +·16 | −·14 | +·26 | −·04 | +·16 | ... |
| 0·4 | + 0·4 | −·50 | −·20 | ·00 | +·60 | +·10 | ... | ·00 | ... | −·60 | ·00 | +·50 | −·40 | +·60 | ... | −·10 | ... |
| 8·9 | 0·2 | −·18 | −·48 | +·02 | +·62 | −·18 | −·48 | −·28 | +·92 | −·64 | −·34 | −·44 | −·14 | −·04 | +·26 | +·76 | +·76 |
| 10·1 | 0·6 | −·18 | −·48 | −·58 | +·62 | −·18 | −·18 | +·32 | +·62 | +·05 | −·55 | −·05 | +·25 | +·05 | −·25 | −·05 | +·55 |
| 10·6 | 0·3 | +·15 | −·45 | ... | ... | −·15 | +·45 | ... | ... | +·37 | −·83 | ... | ... | +·07 | +·37 | ... | ... |
| 0·7 | 1·9 | −·30 | +·00 | −·40 | −·40 | +·60 | ... | +·50 | ... | ·00 | +·30 | +·20 | +·50 | −·30 | ... | −·70 | ... |
| 3·2 | 1·9 | +·14 | +·14 | +·34 | +·34 | −·46 | ... | +·04 | −·56 | +·61 | +·61 | +·81 | +·51 | −·59 | ... | −·99 | −·99 |
| 4·6 | 1·3 | +·12 | −·18 | +·02 | +·02 | −·48 | ... | +·52 | ... | +·30 | −·30 | −·10 | −·70 | ·00 | ... | +·80 | ... |
| 6·0 | 1·4 | +·09 | +·09 | −·61 | −·31 | +·09 | +·09 | +·29 | +·29 | +·31 | −·29 | −·09 | +·21 | +·01 | −·29 | −·09 | +·21 |
| 8·6 | 1·7 | −·30 | ... | ... | ... | +·30 | ... | ... | ... | −·15 | ... | ... | ... | +·15 | ... | ... | ... |
| 1·2 | 2·7 | −·05 | −·05 | −·45 | −·45 | +·55 | ... | +·45 | ... | −·25 | +·05 | −·35 | −1·25 | +1·25 | ... | +·55 | ... |
| 1·5 | 2·6 | +·16 | −·44 | −·24 | +·36 | −·14 | −·14 | +·36 | +·06 | +·01 | −·89 | +·21 | −·39 | +·91 | −·29 | +·51 | −·09 |
| 5·5 | 2·8 | +·24 | +·24 | −·16 | +·14 | +·24 | −·36 | −·16 | −·16 | −·29 | −·59 | −·39 | −·39 | +·31 | +·31 | +·51 | +·51 |
| 5·8 | 2·7 | +·48 | +·48 | +·38 | −·52 | +·18 | −·12 | +·38 | +·08 | −·21 | +·39 | +·29 | +·29 | +·09 | +·09 | −·01 | −·91 |

|  |  | *Discordance of* A *Coordinate from Mean of* 8. |  |  |  |  |  |  |  | *Discordance of* B *Coordinate from Mean of* 8. |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  | 2057 |  |  |  | 2059 |  |  |  | 2057 |  |  |  | 2059 |  |  |  |
| A Coord. on 2057. | B Coord. on 2057. | A.R. $6^{m}$. ″ | A.E. $6^{m}$. ″ | A.R. $3^{m}$. ″ | A.E. $3^{m}$. ″ | A.R. $6^{m}$. ″ | A.E. $6^{m}$. ″ | A.R. $3^{m}$. ″ | A.E. $3^{m}$. ″ | A.R. $6^{m}$. ″ | A.E. $6^{m}$. ″ | A.R. $3^{m}$. ″ | A.E. $3^{m}$. ″ | A.R. $6^{m}$. ″ | A.E. $6^{m}$. ″ | A.R. $3^{m}$. ″ | A.E. $3^{m}$. ″ |
| 7·6 | 2·6 | −·33 | +·87 | +·17 | +·17 | −·33 | −·33 | +·17 | −·43 | +·01 | +·01 | +·21 | +·21 | +·31 | −·29 | −·39 | −·09 |
| 8·2 | 2·8 | −·56 | +·04 | +·24 | +·24 | −·56 | +·04 | −·36 | −·06 | +·24 | +·24 | +·14 | +·14 | +·24 | −·36 | −·16 | −·46 |
| + 8·3 | 2·3 | −·59 | +·01 | +·21 | +·21 | −·89 | +·31 | −·09 | +·81 | −·33 | +·27 | +·17 | +1·07 | −·03 | −·33 | −·43 | −·43 |
| − 1·7 | 3·6 | −·29 | −·59 | −·39 | −·39 | +·61 | +·31 | −·09 | +·81 | +·42 | +·12 | −·28 | −·58 | +·42 | −·18 | +·02 | +·02 |
| − 1·4 | 3·5 | +·20 | +·20 | ... | ... | −·40 | ... | ... | ... | ·00 | ·00 | ... | ... | ·00 | ... | ... | ... |
| + 3·2 | 3·2 | +·61 | +·91 | +·21 | −·09 | −·59 | −·29 | −·39 | −·39 | +·31 | +·31 | −·09 | −·09 | +·01 | −·29 | −·09 | −·09 |
| 5·4 | 4·0 | +·12 | ... | +·28 | ... | +·12 | ... | +·02 | ... | +·65 | ... | −·35 | ... | −·55 | ... | +·25 | ... |
| 11·4 | 3·2 | −·50 | −·20 | ·00 | + 30 | −·20 | ... | +·60 | ... | +·15 | +·45 | −·25 | ·25 | +·15 | ... | −·25 | .. |
| + 10·7 | 3·8 | −·30 | ... | ... | ... | +·30 | ... | ... | ... | +·15 | ... | ... | ... | ·15 | ... | ... | .. |
| − 1·7 | 4·7 | +·23 | +·23 | −·77 | −·47 | −·37 | ... | +1·03 | +·13 | −·16 | −·16 | ·26 | +·04 | −·76 | ... | +·94 | +·34 |
| + 4·9 | 4·9 | +·19 | +·19 | −·21 | +·09 | +·19 | ... | −·21 | −·21 | +·23 | +·23 | +·13 | −·17 | −·67 | ... | +·13 | +·13 |
| 6·6 | 4·7 | +·50 | +·50 | −·50 | −1·10 | +·20 | +·20 | +·10 | +·10 | +·16 | 1·04 | +·06 | −·54 | +·46 | +·46 | +·36 | +·06 |
| 8·7 | 4·3 | −·14 | +·46 | −·24 | −·24 | −·14 | −·14 | +·06 | +·36 | −·03 | +·27 | +·17 | +·47 | −·03 | −·33 | −·43 | −·13 |
| 8·8 | 4·5 | +·39 | −·51 | −·01 | +·59 | −·21 | +·09 | −·31 | −·01 | −·03 | −·03 | +·17 | +·17 | +·27 | −·33 | +·47 | −·73 |
| 12·8 | 4·7 | +·30 | ... | ... | ... | −·30 | ... | ... | ... | +·60 | ... | ... | ... | −·60 | ... | ... | ... |
| 1·6 | 5·3 | +·39 | +·09 | −·01 | +·29 | +·09 | ... | −·31 | −·31 | +·57 | −·03 | +·77 | +·17 | −·33 | −·63 | −·13 | −·43 |
| 3·0 | 5·2 | +·55 | +·25 | −·25 | −·55 | +·55 | ... | −·55 | ... | +·15 | −·15 | +·05 | +·05 | +·15 | ... | −·25 | ... |
| 6·5 | 5·2 | +·19 | +·49 | +·09 | +·39 | −·11 | −·11 | −·51 | +·09 | +·46 | +·46 | −·24 | + 36 | −·44 | −·14 | +·06 | −·54 |
| 7·1 | 5·1 | +·15 | +·15 | −·55 | +·35 | +·15 | ... | −·25 | ... | +·20 | −·10 | −·20 | +·10 | −·40 | ... | +·40 | ... |
| Ω + 10·7 | 5·5 | +·31 | +·31 | −·69 | −·09 | −·29 | −·29 | +·51 | +·21 | +·31 | −·29 | −·09 | −·69 | +·31 | +·01 | +·51 | −·09 |
| − 0·6 | 6·1 | −·14 | +·16 | −·24 | +·06 | −·14 | +·16 | +·06 | +·06 | +1·14 | −·36 | −·16 | −·16 | −·06 | −·36 | −·46 | +·44 |

1894MNRAS..55...60C

| A Coord. on 2057. | B Coord. on 2057. | *Discordance of* A *Coordinate from Mean of* 8. | | | | | | | | *Discordance of* B *Coordinate from Mean of* 8. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2057 | | | | 2059 | | | | 2057 | | | | 2059 | | | |
| | | A.R. $6^m$. | A.E. $6^m$. | A.R. $3^m$. | A.E. $3^m$. | A.R. $6^m$. | A.E. $6^m$. | A.R. $3^m$. | A.E. $3^m$. | A.R. $6^m$. | A.E. $6^m$. | A.R. $3^m$. | A.E. $3^m$. | A.R. $6^m$. | A.E. $6^m$. | A.R. $3^m$. | A.E. $3^m$. |
| + 0·7 | 6·7 | +″·06 | +″·36 | −″·64 | −″·64 | +″·66 | ″ ... | +″·26 | −″·04 | −″·11 | −″·41 | −″·21 | −″·21 | +″·49 | ″ ... | +″·69 | −″·21 |
| 1·4 | 6·2 | +·00 | ... | ... | ... | ·00 | ... | ... | ... | +·30 | ... | ... | ... | −·30 | ... | ... | ... |
| 5·3 | 6·9 | −·25 | −·25 | −·15 | +1·05 | −·25 | +·05 | −·85 | +·65 | +·61 | −·29 | +·21 | −·09 | −·29 | −·59 | +·21 | +·21 |
| 8·6 | 6·6 | −·36 | −·06 | −·16 | +·74 | −·06 | −·05 | −·16 | +·14 | +·27 | +·57 | +·17 | −·43 | −·03 | +·27 | −·43 | −·43 |
| 0·3 | 7·2 | −·30 | ... | ... | ... | +·30 | ... | ... | ... | −·15 | ... | ... | ... | +·15 | ... | ... | ... |
| 1·0 | 7·8 | +·30 | −·30 | +·20 | −·10 | +·60 | ... | −·70 | ... | +·70 | +·10 | −·30 | −·30 | +·10 | ... | −·30 | ... |
| 4·5 | 8·2 | +·15 | ... | ... | ... | −·15 | ... | ... | ... | +·30 | ... | ... | ... | −·30 | ... | ... | ... |
| 5·8 | 8·7 | +·37 | −·53 | ... | ... | +·67 | −·53 | ... | ... | −·08 | −·38 | ... | ... | +·52 | −·08 | ... | ... |
| 5·9 | 8·8 | +·10 | +·10 | ... | ... | −·20 | ... | ... | ... | ·00 | −·60 | ... | ... | +·60 | ... | ... | ... |
| 9·2 | 8·3 | −·15 | ... | ... | ... | +·15 | ... | ... | ... | −·45 | ... | ... | ... | +·45 | ... | ... | ... |
| + 3·0 | 9·9 | +·15 | −·15 | ... | ... | +·15 | −·15 | ... | ... | ·00 | −·60 | ... | ... | ·60 | ·00 | ... | ... |
| − 0·8 | 10·2 | +·35 | −·25 | +·25 | −·35 | +·05 | +·35 | −·35 | −·05 | +·35 | −·25 | −·65 | −·35 | +·35 | +·05 | +·85 | −·35 |
| + 4·6 | 10·4 | −·21 | −·21 | −·31 | ... | +·09 | +·69 | +·59 | ... | −·67 | −·07 | +·43 | ... | +·23 | −·07 | +·13 | ... |
| − 1·6 | 12·9 | +·54 | +·54 | −·46 | +·14 | −·06 | −·06 | −·46 | −·16 | −·31 | −·61 | +·79 | −·41 | +·29 | −·31 | +·49 | −·11 |
| + 7·7 | 12·6 | −·24 | +·36 | −·14 | −1·04 | +·96 | +·36 | −·14 | −·14 | +·35 | −·85 | +·85 | −·65 | +·65 | +·05 | +·25 | −·65 |
| 8·6 | 12·3 | +·44 | +·44 | −·36 | −·66 | +·44 | +·44 | −·36 | −·36 | +·41 | −·49 | −·29 | −·59 | +·41 | +·41 | +·31 | −·29 |
| 1·8 | 13·4 | +·46 | −·14 | +·66 | +·66 | −·14 | −·74 | −·24 | −·54 | −·55 | +·05 | +·55 | +·25 | +·05 | −·25 | +·55 | −·65 |
| + 10·5 | + 13·2 | −·14 | +·46 | −·54 | −·24 | +·46 | −·14 | +·36 | −·24 | +·76 | +·16 | +·36 | +·36 | +·16 | −·14 | −·24 | −1·44 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | −·15 | ... | ... | ... | +·15 | ... | ... | ... |
| Mean discordance | | ±·29 | ±·30 | ±·31 | ±·38 | ±·30 | ±·27 | ±·30 | ±·32 | ±·30 | ±·33 | ±·31 | ±·36 | ±·31 | ±·25 | ±·38 | ±·43 |

1894MNRAS..55...60C

These discordances seem somewhat large in some cases, but it is to be remarked that they were obtained from the first measures made with the glass scale, and that none have been rejected, though later examination showed that they were sometimes rather rough in consequence of the want of familiarity of the measurers with their instruments. Nor has any correction been applied for the errors of *réseau*, or for distortion. Considering that these discordances are derived from the comparison of measures on two plates, they seem to show that a satisfactory degree of accuracy can be obtained by the simple method of measurement used.

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## *On the Proper Motions of Three Stars in the Constellation Ophiuchus.* By W. T. Lynn, B.A.

In the *Monthly Notices* for 1870 November I gave the proper motions, deduced from Airy's Greenwich Catalogues, of the double star 36 (A) *Ophiuchi* and of a star which in *Flamsteed* is the 30th catalogued in the constellation *Scorpio*, and is therefore called 30 *Scorpii* in Baily's *Flamsteed*, though Baily notes that it should have been included by *Flamsteed* in the constellation *Ophiuchus*, and it is therefore so arranged in the B.A.C., where it is given (without a constellation number) as No. 5813. In the Twelve-year Catalogue and in the two Seven-year Catalogues (it does not appear in the Six-year or in the Nine-year) Flamsteed's number, 30 *Scorpii*, is retained; but in the Ten-year Catalogue (in which it is No. 2696) it is called in the text *Bradley* 2179.

I have thought it would be worth while to supplement my former paper by computing the proper motions of these stars from the later Greenwich Catalogues, and here set down all the places of the three which are given in them, from the first Seven-year to the Ten-year.

| Authority. | Epoch. | A$^1$ Ophiuchi. R.A. | No. of Obs. | A$^2$ Ophiuchi. R.A. | No. of Obs. | Bradley 2179. R.A. | No. of Obs. |
|---|---|---|---|---|---|---|---|
| | | h m s | | h m s | | h m s | |
| 7-year for | 1860 | 17 6 44·47 | 12 | 17 6 44·67 | 9 | 17 7 37·18 | 8 |
| 7-year ,, | 1864 | 17 6 59·27 | 3 | 17 6 59·33 | 1 | 17 7 51·80 | 2 |
| 9-year ,, | 1872 | 17 7 28·583 | 5 | 17 7 28·816 | 3 | ... | ... |
| 10-year ,, | 1880 | 17 7 58·105 | 10 | 17 7 58·314 | 8 | 17 8 50·846 | 4 |
| | | N.P.D. | | N.P.D. | | N.P.D. | |
| | | ° ′ ″ | | ° ′ ″ | | ° ′ ″ | |
| 7-year for | 1860 | 116 23 35·06 | 12 | 116 23 31·26 | 9 | 116 20 25·21 | 8 |
| 7-year ,, | 1864 | 116 23 59·08 | 3 | 116 23 55·01 | 1 | 116 20 47·77 | 2 |
| 9 year ,, | 1872 | 116 24 42·45 | 5 | 116 24 38·08 | 2 | ... | ... |
| 10-year ,, | 1880 | 116 25 31·03 | 11 | 116 25 25·93 | 9 | 116 22 17·17 | 4 |